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Translating Herbal Potency into Dosage Form: Devolopment and Evaluation of Moringa Oleifera Enriched Lozenges

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ABSTRACT

This study developed a Moringa oleifera lozenge as a potential herbal oromucosal delivery system for throat and oral care. The optimized formulation showed good physicochemical properties, uniform drug content, acceptable mechanical strength, and approximately 92% phytoconstituent release within 30 minutes. Taste-masking effectively reduced the natural bitterness of *Moringa oleifera*, improving palatability. The formulation demonstrates promising potential for providing antimicrobial, antioxidant, and soothing effects in the oral cavity, with possible applications in throat irritation, oral infections, and mucosal inflammation. Further in vivo and clinical studies are needed to confirm its therapeutic efficacy and safety.

1. INTRODUCTION

Oral drug delivery is one of the most preferred routes because of its convenience, high patient compliance, and large absorptive surface. Lozenges are medicated solid dosage forms that dissolve slowly in the mouth, providing prolonged local and systemic therapeutic effects while improving patient compliance, especially in children and older adults. They also help avoid first-pass metabolism and can be administered without water.

Oral infections commonly affect the tongue, buccal mucosa, palate, and tooth surfaces, making effective local drug delivery essential. Herbal lozenges have gained attention as safe and effective alternatives for managing oral infections and throat irritation.

Moringa oleifera, commonly known as the *Miracle Tree* or drumstick tree, is a highly nutritious medicinal plant widely distributed in tropical and subtropical regions. It is rich in vitamins, minerals, proteins, flavonoids, phenolic compounds, carotenoids, and isothiocyanates, which possess antioxidant, antimicrobial, anti-inflammatory, antihyperglycemic, and immunomodulatory properties. Traditionally, different parts of the plant have been used to treat ulcers, toothache, hypertension, infections, digestive disorders, anaemia, and malnutrition.

The slow dissolution of a Moringa oleifera lozenge enables sustained release of its phytoconstituents in the oral cavity, providing prolonged antimicrobial and soothing effects. The natural mucilage present in the leaves may also improve mucosal retention by forming a protective layer over irritated tissues.

Due to its excellent nutritional value, therapeutic potential, safety profile, and easy availability, Moringa oleifera is a promising candidate for herbal lozenge formulation. However, its application in oral drug delivery remains underexplored, highlighting the need for further research to develop effective herbal lozenges for oral health management.

Types of Lozenges

A. Chewable Lozenges:

In chewable lozenges, the active ingredients are incorporated into a caramel-based matrix, so they are chewed rather than allowed to dissolve in the mouth. These formulations typically contain glycerine, gelatine, and water. They are highly flavoured, often with fruit Flavors, and may have a slightly acidic taste to mask the unpleasant taste of glycerine. Chewable lozenges are mainly intended for paediatric use, enabling drug absorption through the gastrointestinal tract to achieve systemic effects. The glycerine base used is similar to that in glycerine or glycerinated gelatine suppositories, usually composed of 70% glycerine, 20% gelatine, and 10% purified water. [Mendes RW., et al.,2006]

B. Hard Lozenges:

Hard lozenges consist of a mixture of sugars and carbohydrates in a non-crystalline, amorphous, or glassy state and are sometimes referred to as sugar syrups. Their weight typically ranges from 1.5 to 4.5 g, [Batheja P, et al., 2006] with a moisture content of about 0.5–1.5%. These lozenges dissolve directly in the mouth rather than disintegrating. Since their preparation involves high temperatures, heat-sensitive ingredients cannot be incorporated. They are commonly used for relieving sore throat, treating throat infections, and reducing irritation by delivering drugs with topical aesthetic or antibacterial properties.

C. Soft Lozenges:

Soft lozenges are designed for the gradual release of drugs in the oral cavity. They are prepared using bases such as polyethylene glycol (PEG), chocolate, or acacia, with some formulations also containing silica gel. Acacia plays a key role in providing desirable texture and smoothness. PEG-based lozenges may soften at elevated temperatures and are hygroscopic, so they should be stored in a cool and dry environment.

D. Compressed Lozenges:

Compressed lozenges are suitable for formulating heat-sensitive ingredients that cannot withstand the high temperatures used in hard or soft lozenge preparation. These are produced using a compression technique similar to tablet manufacturing. Unlike conventional tablets, they are formulated to dissolve slowly and do not disintegrate rapidly. Granulation methods are commonly employed in their preparation. [James M Diet al.,2006]

Chronological Development of Lozenges

Lozenges have been used for centuries as medicated oral dosage forms. Ancient Egyptians prepared herbal candies using honey, while later formulations included medicines for cough relief. They are also known as cough drops, throat sweets, troches, pastilles, and cachous.

Lozenges are solid, flavoured, and sweetened preparations designed to dissolve slowly in the mouth, allowing the gradual release of medication. They are commonly used to relieve cough, sore throat, oral infections, and common cold symptoms, providing prolonged local therapeutic action.The term "lozenge"

originates from the French word for a diamond-shaped figure, reflecting its traditional shape. Unlike liquid medicines, lozenges are taken without water and release the drug slowly in the oral cavity.
Although lozenges were traditionally prepared in pharmacies, they are now manufactured commercially and remain an effective dosage form for prolonged drug delivery in the mouth and throat.

2. PLANT DOSSIER:

2.1 MORINGA OLEIFERA

Moringa oleifera, commonly known as the drumstick tree or horseradish tree, is a fast-growing medicinal plant native to India and other South Asian countries. Due to its natural origin, rich nutritional value, and minimal side effects, it has gained worldwide popularity in herbal medicine and is widely used in traditional systems such as Ayurveda, Unani, Siddha, Homeopathy, and Naturopathy. The plant contains numerous bioactive compounds, including quercetin, kaempferol, zeatin, beta-sitosterol, caffeoylquinic acid, terpenoids, alkaloids, tannins, and isothiocyanates, along with essential minerals such as calcium, iron, potassium, magnesium, zinc, copper, and manganese.
Moringa leaves are highly nutritious, providing significantly higher amounts of vitamins and minerals than many common foods. They are rich in vitamin A, vitamin C, calcium, potassium, iron, protein, essential amino acids, and antioxidants, which contribute to their antioxidant, antimicrobial, anti-inflammatory, and antidiabetic properties. Different parts of the plant, including the leaves, seeds, bark, flowers, roots, and pods, have been traditionally used to treat various diseases. Moringa also supports digestive health, may help regulate blood glucose, exhibits antibacterial activity against *Helicobacter pylori*, and its seeds are widely used for water purification. Because of its exceptional nutritional composition and broad pharmacological activities, Moringa oleifera is considered a valuable medicinal plant with significant potential for the development of herbal pharmaceutical formulations.

Fig 1 . MORINGA OLEIFERA

2.2 SYNONYMS OF MOREINGA OLEIFERA

Synonyms: The plant Moringa oleifera is known by Several names throughout the world. The synonyms are given below.

- Latin – Moringa oleifera
- Sanskrit – Subhanjana,
- Hindi – Saguna, Sainjna
- Gujarati – Suragavo
- Tamil – Mulaga , Munaga
- Malayalam – Murinna, Sigru
- ·Punjabi – Sainjna, Soanjna
- Unani – Sahajan
- Ayurvedic – Haritashaaka, Raktaka, Akshiva
- Arabian – Rawag,
- French – Morungue
- Spanish – Angela, Ben, Moringa
- Chinese – La ken
- English - Drumstick tree, Horseradish tree

2.3 BIOLOGICAL SOURCE : The dried leaves, seeds, pods, flowers, and roots of Moringa oleifera Lam., belonging to the family Moringaceae."

2.4 GEOGRAPHICAL SOURCE: Moringa oleifera is native to the sub-Himalayan tracts of northern India, Pakistan, Nepal, and parts of Bangladesh. While originating in these regions around 2000 BC, it is now cultivated worldwide in tropical and subtropical regions, including Africa, Asia, and Latin America.

2.5 TAXONOMICAL CLASSIFICATION:

· Kingdom – Plantae
· Sub kingdom – Tracheobionta
· Super Division – Spermatophyta
· Division – Magnoliophyta
· Class – Magnoliopsida
· Sub class – Dilleniidae
· Order – Capparales
· Family – Moringceae
· Genus – Moringa
· Species – oleifera

Table no 1. Taxonomical classification of moringa oleifera

2.6 Moringa Nutrition content

Nutritional analysis	Pods (per 100 g)	Fresh leaves (per 100 g)	Dried leaves (per 100 g)
Moisture %	86.9	75	7.5
calories	26	92	205
Protein (g)	2.5	6.7	27.1

Fat (g)	0.1	1.7	2.30
Carbohydrate (g)	3.7	13.4	38.2
Fibre (g)	4.8	0.9	19.2
Minerals (g)	2	2.3	-
Calcium (mg)	30	440	2003
Magnesium (mg)	24	24	368.0
Phosphorous (mg)	110	70	204.0

Table no 2: moringa nutrition content [Abarams et al.,1993]

2.7 Traditional uses of moringa oleifera

1. Seeds are traditionally used for water purification due to natural coagulating proteins.
2. Twigs are used as natural toothbrush (chewing sticks) for oral hygiene.
3. Leaf paste is applied as a wound healing poultice for cuts, burns, and ulcers.
4. Seed oil (ben oil) is used for skin protection and anti-aging purposes.
5. Leaves and roots are used in folk medicine as supportive remedy in snake and insect bites.
6. Leaves are consumed to enhance lactation in nursing mothers.
7. Decoction of leaves and bark is used to reduce fever and support malaria treatment.
8. Traditionally used as a brain tonic to improve memory and mental clarity.
9. Extracts are used for food preservation due to antimicrobial properties.
10. Leaves are used as nutritional supplement in livestock feed to improve health and milk production.

3. Literature Review

[Ben Bassat N, et al.,2013]

Herbal lozenge formulations are increasingly utilized among the Thai population in contemporary practice. Lozenges are solid dosage forms designed to dissolve slowly in the mouth or pharynx, allowing for localized as well as systemic therapeutic effects. Additionally, lozenges may facilitate systemic drug absorption. Their effectiveness largely depends on their ability to dissolve readily within the oral cavity. Various herbal lozenge formulations, including those containing marshmallow root extract and Salvia officinalis, have been developed to improve therapeutic efficacy and patient acceptability.

[Fahey J W. et al2005]

Moringa oleifera Lam. (commonly known as Marum) is one of the most extensively cultivated species of the Moringaceae family, valued both as a dietary vegetable and a medicinal plant. The leaves of M. oleifera serve as a rich source of essential nutrients, including vitamins and minerals such as calcium.

[Sreelatha S, et al.,2009]

Moringa oleifera leaf preparations are commercially available in dosage forms such as capsules, tea bags, and boluses. Therefore, the present study aims to develop a lozenge formulation containing M. oleifera leaf extract, offering a novel and effective alternative for herbal drug delivery.

[Rong Liu, et al.,2022]

Moringa oleifera provides four major edible parts including leaves, pods, flowers, and seeds. The leaves are considered highly nutritious as they contain proteins, β-carotene, vitamins A, B, C, and E, riboflavin, folic acid, pyridoxine, amino acids, minerals, phenolic compounds, phytochemicals, and omega-3 and

omega-6 fatty acids. Moringa leaves mainly contain palmitic and linolenic acids, while the seeds are rich in oleic acid.

[Ashutosh Pareek, et al.,2023]

Moringa oleifera grows quickly in sandy, well-drained loamy soil and commonly thrives at elevations around 500 m above sea level. The plant is generally small to medium in height with naturally tripinnate leaves. Its flowers develop on inflorescences measuring about 10–25 cm in length, while the fruits are elongated pods that are usually three-sided. The trunk is mostly straight, although it may sometimes develop irregularly. The branches are arranged unevenly, forming an umbrella-like canopy. The brown seeds possess a semi-permeable seed coat, and a single tree can produce nearly 15,000–25,000 seeds annually.

[Rong Liu, et al.,2022]

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7. [Swetha Yogananadan]

Various advanced technologies have been developed to improve conventional lozenge formulations. These advancements involve the use of novel ingredients and improved manufacturing techniques to enhance taste, reduce calorie content, accelerate production, and optimize drug release characteristics. Pharmaceutical lozenges offer the advantage of extending the retention time of the dosage form in the oral cavity, thereby improving bioavailability, reducing gastrointestinal irritation, and minimizing first-pass metabolism.

8. [Xinyue Su, et al.,2023]

Literature reports that the bitter taste of Moringa oleifera extract is one of the major difficulties encountered during formulation development. Hence, recent research suggests incorporating taste-masking techniques, sweetening agents, and flavouring substances to enhance palatability, patient acceptance, and compliance in herbal lozenge formulations.

9. Ashutosh Pareek [et al.,2023]

3.1 Excipients used in moringa Enriched lozenges

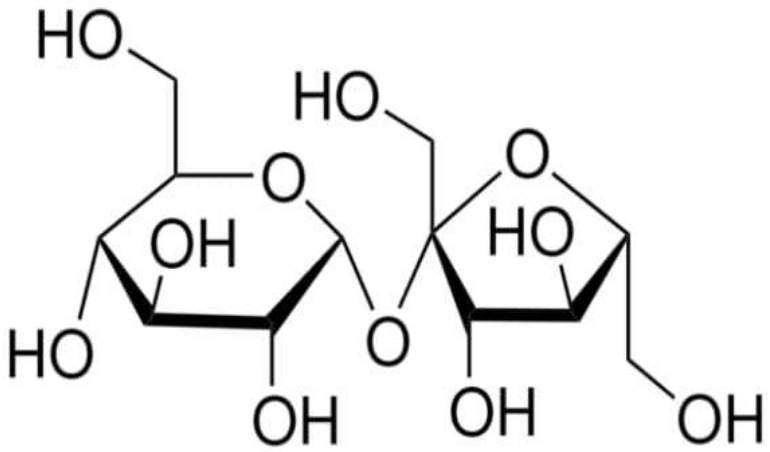
Sr no	Excipients	Compatibility profile	Roles
1	Sucrose	compatible	a. Bulking agent b. sweetening agent c. Binder d. dissolution control e. preservative effect crystallization behaviour

2	Citric acid	compatible	a. antioxidant b. pH modifier c. saliva stimulation d. effervescent
3	Gum acacia	compatible	a. binder b. Dem esculent c. viscosity enhancer d. controlled drug release
4	Magnesium stearate	compatible	a. lubricant b. antiadhrent flow promoter enhance product uniformity
5	Peppermint/menthol	compatible	a. flavouring agent cool and soothing effect c. fleshing effect

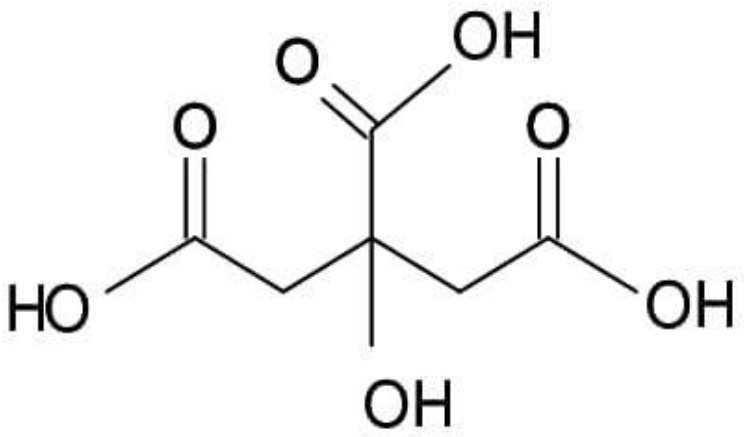
Table no 3. Excipients used in moringa oleifera lozenges

3.2 Structural characterization of excipients

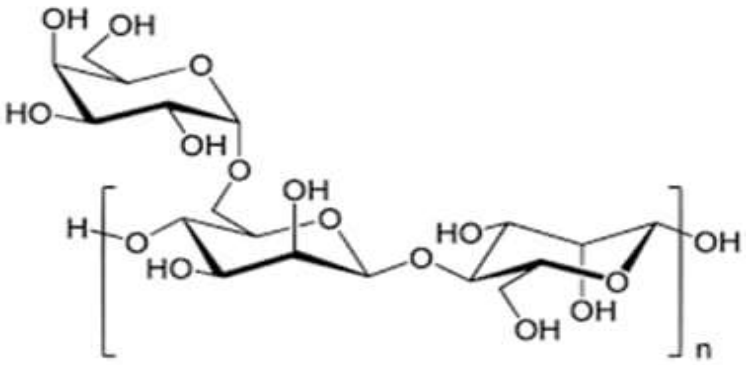
1.sucrose



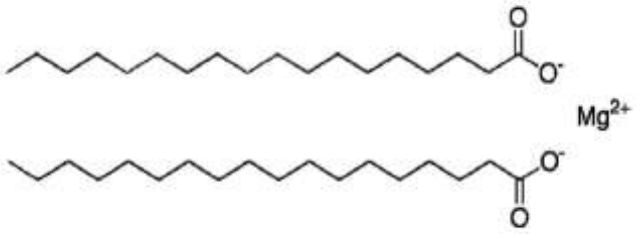
2.citric acid



3.Gum acacia



4.magnesium stearate



5.peppermint

4. Rational of study

Moringa oleifera, known as the "miracle tree," is rich in bioactive compounds such as flavonoids, phenolic acids, vitamins, and minerals, which possess antioxidant, anti-inflammatory, and antimicrobial properties. These therapeutic benefits make it a promising medicinal plant for herbal drug development.

Lozenges are solid dosage forms that dissolve slowly in the mouth, providing prolonged drug release and localized treatment for sore throat, oral infections, and throat irritation. Incorporating Moringa oleifera leaf extract into lozenges improves patient compliance, ease of administration, and the stability of herbal constituents while enabling controlled release of active compounds.

Well-formulated herbal lozenges can achieve satisfactory physicochemical properties, including uniform weight, adequate hardness, low friability, and good stability. Standardization using High-Performance Liquid Chromatography (HPLC) ensures consistent levels of key phytoconstituents, such as quercetin, thereby improving the quality, safety, and reproducibility of the formulation. Therefore, this study aims to develop and evaluate Moringa oleifera lozenges as a novel herbal dosage form for effective oral drug delivery and improved therapeutic outcomes.

5. AIM AND OBJECTIVE

Aim of the Study

To design, formulate, and systematically evaluate lozenges incorporating Moringa oleifera leaf extract, with the objective of developing a pharmaceutically stable, therapeutically effective, and patient-compliant herbal dosage form for the management of oral and pharyngeal disorders.

Objectives of the Study

- To formulate lozenges containing Moringa oleifera leaf extract employing appropriate pharmaceutical excipients and standardized formulation techniques.
- To optimize the formulation with respect to physicochemical and organoleptic characteristics to ensure product acceptability and uniformity.
- To perform comprehensive evaluation of the formulated lozenges, including parameters such as hardness, friability, weight variation, thickness, and disintegration profile, in accordance with pharmacopeial guidelines.
- To conduct stability studies under defined environmental conditions to assess the integrity and shelf-life of the formulation.
- To develop a convenient and patient-friendly herbal dosage form that enhances therapeutic effectiveness in the treatment of throat irritation, oral infections, and related conditions.
- To assess the palatability and mouthfeel characteristics of the developed lozenges, including taste masking efficiency, to enhance patient acceptability and compliance.

6. Plan of Work

The present investigation will be carried out in a systematic and sequential manner to ensure the successful development and evaluation of Moringa oleifera leaf extract lozenges. The study will be executed through the following stages:

1. Literature Review

An extensive and critical review of the available scientific literature will be conducted to gather relevant information on Moringa oleifera, its phytochemical constituents, pharmacological activities, and its application in novel dosage forms, particularly lozenges.

2. Procurement and Authentication of Plant Material

Fresh leaves of Moringa oleifera will be procured from a reliable source and authenticated by a qualified botanist to ensure the accuracy and quality of the plant material.

3. Preparation of Plant Extract

The collected leaves will be cleaned, dried under controlled conditions, and subjected to suitable extraction methods (such as solvent extraction) to obtain the crude extract rich in active phytoconstituents.

4. Preformulation Studies

Preliminary studies including organoleptic evaluation, solubility analysis, and drug–excipient compatibility studies will be performed to establish the physicochemical characteristics of the extract.

5. Formulation of Lozenges

Lozenges will be formulated using appropriate excipients by suitable techniques (e.g., moulding or compression method) to obtain a uniform and stable dosage form.

6. Optimization of Formulation

Different formulation batches will be prepared by varying excipient composition to achieve optimal physicochemical properties and acceptable organoleptic characteristics.

7. Evaluation of Lozenges

The prepared lozenges will be evaluated for various quality control parameters, including hardness, friability, weight variation, thickness, disintegration time, and uniformity, in accordance with standard pharmacopeial guidelines.

8. Phytochemical and Analytical Evaluation

Qualitative and quantitative analysis of active constituents (such as flavonoids) will be carried out using appropriate analytical techniques to ensure consistency and efficacy.

9. In Vitro Release Studies

Dissolution studies will be performed to evaluate the release profile of active constituents and to understand the drug release kinetics.

10. Stability Studies

The optimized formulation will be subjected to stability studies under specified environmental conditions to assess its shelf-life and stability over time.

11. Data Analysis and Interpretation

All experimental data will be systematically recorded, statistically analysed, and interpreted to draw valid conclusions regarding the formulation's performance.

7. Materials and instrument

7.1 Materials

- Moringa oleifera leaf extract
- Sucrose (sweetening agent)
- Citric acid (antioxidant)
- Gum acacia (binder)
- Magnesium stearate (lubricant}
- Peppermint (flavouring agent)
- Tartrazine

7.2 Glassware's

- Beakers (100ml.250ml,500ml)

- Measuring cylinder (25ml,50ml,100ml)
- Funnel
- Pert dishes
- Round bottom flask
- Filter paper
- Glass rod
- Watch glass

7.3 Instruments

- Analytical balance (for accurate weighing of ingredients)
- Hot air oven (for drying of plant material)
- Mechanical grinder or pulveriser (for size reduction)
- Sieve set (for particle size uniformity)
- Heating mantle or water bath (for preparation of base)
- Mortar and pestle (for mixing)
- Molds (for lozenge preparation)
- Monsanto hardness tester (for hardness evaluation)
- Roche friabilator (for friability testing)
- Vernier calliper (for thickness measurement)
- Disintegration test apparatus
- Dissolution test apparatus (for in vitro release studies)

8. Experimental work and methodology

Experimental Work

1. Preparation of Moringa oleifera Leaf Extract

Fresh leaves of Moringa oleifera were collected, washed thoroughly, and shade-dried to preserve thermolabile constituents. The dried material was pulverized using a mechanical grinder and passed through a suitable sieve to obtain uniform particle size. The powdered drug was subjected to solvent extraction using a suitable solvent system. The extract was concentrated and dried to obtain a semisolid mass, which was stored in an airtight container for further use.

2. Formulation of Lozenges

1. Preparation of Lozenges (Heating and Congealing Method)

a. Weighing of Ingredients

Accurately weigh the required quantity of sucrose and other excipients required

b. Heating of Sucrose

Heat sucrose in a suitable vessel with continuous stirring. Continue heating until a clear, viscous syrup is formed. preparation of syrup base was prepared by dissolving required amount of sucrose in distilled water at 140℃ and continuously stirring for 30 -40 mins.

2. Temperature Control

Maintain proper temperature to prevent decomposition or caramelization of sugar up to 140℃-150℃ c until it the syrup breaks.

3. Incorporation of Active Ingredient

Add the prepared Moringa oleifera extract to the syrup. Mix continuously to ensure uniform distribution.

4. Addition of Binding Agent
Add gum acacia to improve cohesiveness and binding of the formulation.
5. Addition of Acidulant
Add citric acid to enhance taste and provide a slight acidic flavour.
6. Mixing
Stir the mixture thoroughly to obtain a homogeneous mass.
7. Molding
Pour the prepared mass into pre-lubricated Molds of desired shape.
8. Cooling and Solidification
Allow the Molds to cool at room temperature until the lozenges solidify.
9. Removal from Molds
Carefully remove the solidified lozenges from the Molds.
10. Drying
Dry the lozenges in a hot air oven to remove excess moisture.
11. Packaging
Pack the lozenges in suitable moisture-resistant packaging.

3. Formulas of preparation of moringa oleifera lozenges:

Sr no	Ingredients	F1	F2	F3	F4	F5	F6
1	Moringa	750 mg	750 mg	750 mg	750 mg	750 mg	750 mg
2	Sucrose	1700 mg	1700 mg	1800 mg	1800 mg	1900 mg	1900 mg
3	Citric acid	60 mg	65 mg	70 mg	65 mg	70 mg	75 mg
4	Acacia	90 mg	110 mg	130 mg	90 mg	110 mg	130 mg
5	Magnesium stearate	60 mg	60 mg	65 mg	65 mg	70 mg	70 mg
6	Menthol	q.s	q.s	q.s	q.s	q.s	q.s
7	distilled water	q.s	q.s	q.s	q.s	q.s	q.s
8	Total weight	2660 mg	2685 mg	2815 mg	2770 mg	2900 mg	2925 mg

Table no 4. composition of moringa oleifera lozenges

Fig no 6. Formulated moringa olifera lozenges

4. Optimized formula

Sr no	ingredients	F1
1	moringa	750 mg
2	sucrose	1700 mg
3	Citric acid	60 mg
4	Acacia	90 mg
5	Magnesium stearate	60 mg
6	menthol	q.s
7	distilled water	q.s
8	Total weight	2660 mg

Table no. 5 optimized formula for moringa olefera lozenges

5.evaluation parameters

1. Genral Appearance

Colour

Light green to yellowish-green

(due to presence of Moringa oleifera extract and slight heating effect)

Odour

Characteristic herbal odour, Slight sweet smell due to sucrose

Taste

Sweet with a mild bitter aftertaste (bitterness from moringa, balanced by sugar and citric acid)

Touch (Texture)

Hard and smooth surface, slightly sticky

2. weight variation:

Lozenges were randomly checked for the uniform weight of lozenges. were 5 lozenges is selected to perform weight variation test, then average weight of lozenges for each batch is calculated and also devia-

tion.

2 lozenges from average weight are greater than acceptance limit shall be accepted.

Sr no	Weight of lozenges	Average weight
1	2.60 g	3.08g
2	3.47g	
3	3.07 g	
4	3.36 ga	
5	2.93 g	

a) Acceptance criteria:

1. individual weight should not more than ± 5% from average weight.
2. maximum 2 lozenges can be deviated but it should not more than ± 10%

b) formula

% Deviation = Individual weight -average weight × 100

Average weight

3.Hardness:

5 lozenges are randomly taken .it is based on principal of ordinary plier. Monsanto hardness tester is used for checking the hardness of lozenges. The lozenges are placed between the jaw of plier and pressure is applied by pressing the handle with hand unit until the lozenge's breaks. The reading of the dial indicates pressure needed to break the lozenges

Sr no	Hardness (kg/cm^2)
1	15.7
2	15.6
3	15.3
4	15.4
5	15.6

Fig no 7. Monsanto hardness tester

4. Friablity test

Normally during the course of compression of lozenges a sufficient pressure is applied on the granules, so that the lozenges can withstand the wear and tear during transportation and handling. friability test is performed to evaluate the ability of the lozenges to withstand wear and tear in packing, handling and transporting. The appearance used to perform this test is known as friablator.

Fig no 8. Roches friablilator

Sr no	Initial weight	Final weight
1	2.60	2.57
2	3.47	3.44
3	3.07	3.04
4	3.36	3.33
5	2.93	2.90
Total weight	15.43	15.28

Formula:

% friability = initial weight-final weight ×100

Initial weight

= 15.43-15.28 ×100

15.43

= 0.97

The friability test of the prepared lozenges shows acceptable mechanical strength. The % friability was within the official limit of not more than 1%, indicating that the lozenges posse's sufficient resistance to abrasion and handling during packing and transportation.

5. thickness:

the thickness of lozenges is the only dimensional variable related to the process. The thickness of individual lozenges may be measures by vernier capillary.

Sr no	Thickness (mm)
1	4.8

2	5.2
3	5.0
4	5.1
5	4.9
Average thickness	5.0

The thickness of prepared lozenges was found to be uniform and within acceptable limit. The average thickness was approximately 5.0 mm, which indicates proper compression and uniformity of the formulation.

6. Dissolution test

Place 1000 ml of phosphate buffer and previously warm temperature 37.5°C into the vessels. place the lozenges in the basket. Start the motor and adjust the rotation speed to 50-100 rpm. withdraw the volume of solution from the vessels after 5 mins. filter and determine the amount of active ingredient present in it by uv spectroscopy. repeat the complete operation 5 times upto 30 mins.

Time(min)	% of drug release
5	22%
10	41%
15	58%
20	72%
25	84%
30	92%

The dissolution study of the prepared lozenges showed gradual and uniform drug release. Approximately 92% of the drug was released within 30 minutes, indicating satisfactory dissolution characteristics of the formulation.

Fig no 9. dissolution apparatus

7. Drug content

The drug content of the prepared lozenges was determined by the UV spectrophotometric method. One lozenge was accurately weighed and crushed into a fine powder using a mortar and pestle. An amount of powder equivalent to the required drug quantity was transferred into a 100 mL volumetric flask containing

a suitable solvent such as phosphate buffer or distilled water. The mixture was shaken thoroughly and sonicated to ensure complete dissolution of the drug. The volume was then made up to 100 mL with the same solvent and filtered using Whatman filter paper. An appropriate dilution of the filtrate was prepared and the absorbance was measured using a UV-visible spectrophotometer at the selected wavelength. A standard drug solution was prepared similarly and its absorbance was recorded. The percentage drug content of the lozenges was calculated using the ratio of sample absorbance to standard absorbance multiplied by 100.

Drug Content Calculation of Individual Lozenges

Assume standard absorbance = 0.500

Sr no	Sample absorbance	Drug content (%)
1	0.492	98.4%
2	0.496	99.2%
3	0.489	97.85%
4	0.503	100.6%
5	0.495	99.0%

$$\% \text{ Drug content} = \frac{\text{Absorbance of test sample}}{\text{Absorbance of test standard}} \times 100$$

Fig no .10 uv visible spectroscopy

9. Result and Discussion

weight variation Test

Sr no	Weight of lozenges	Average weight
1	2.60 g	3.08g
2	3.47g	
3	3.07 g	
4	3.36 ga	
5	2.93 g	

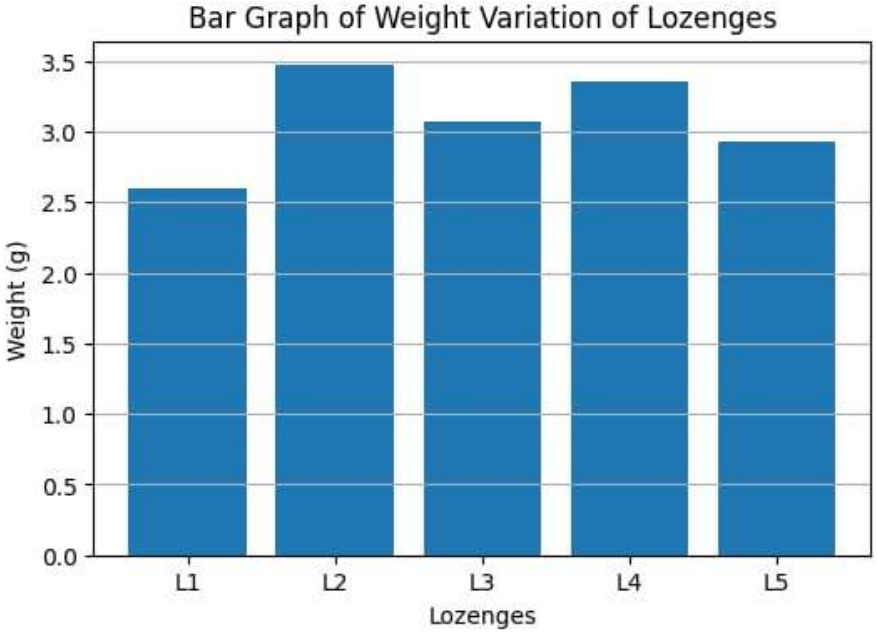
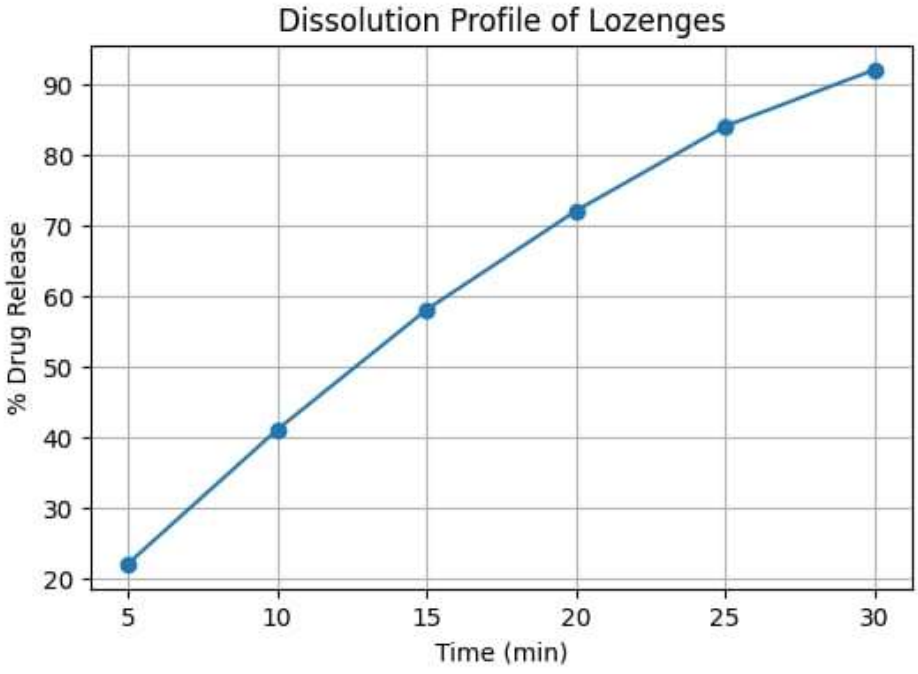


Fig no 11. Weight variation

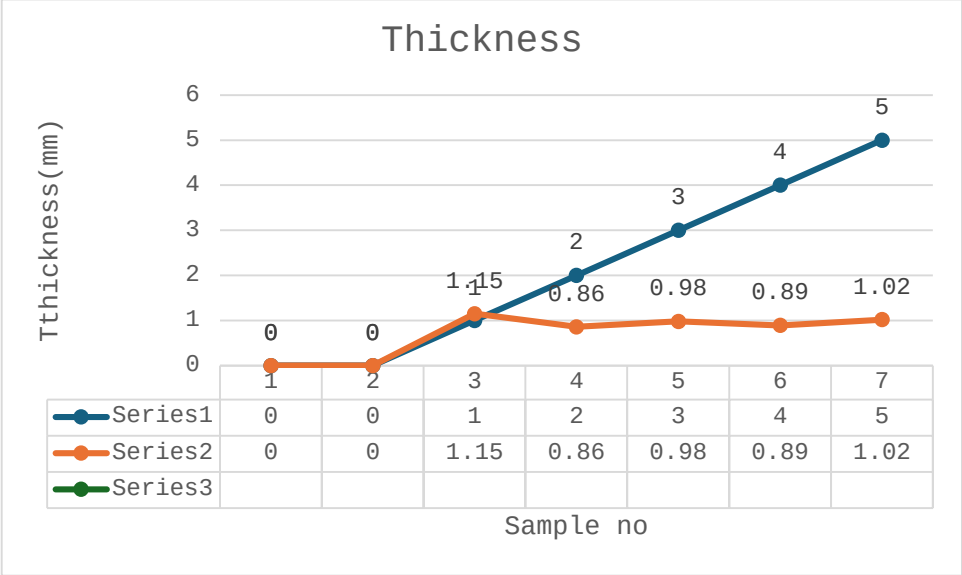
Drug content:

Sr no	Sample absorbance	Drug content (%)
1	0.492	98.4%
2	0.496	99.2%
3	0.489	97.85%
4	0.503	100.6%
5	0.495	99.0%

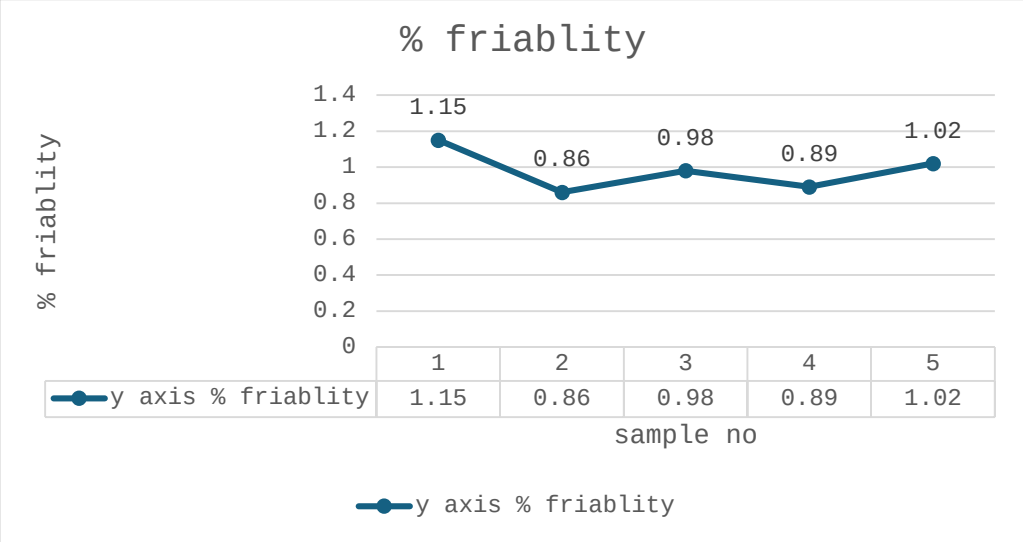


Result: Average drug content = 99% The values are within the acceptable limit of 90–110%.

Thickness:



Friability:



Result: % friability of total lozenges is found to be 0.97% and %friability of individual lozenges is found to be 0.86 to 1.15%.

10. Therapeutic Effect of Moringa Oleifera Lozenges

1. **Antidiabetic Activity** :- *Moringa oleifera* leaf extracts exhibit significant antidiabetic activity by lowering blood glucose levels, increasing insulin secretion, and reducing oxidative stress. Animal studies have demonstrated improved glycaemic control and protection of pancreatic tissues.
2. **Cardiovascular Activity** :- Ethanolic leaf extracts show antihypertensive and hypotensive effects due to the presence of thiocarbamate and isothiocyanate glycosides, which help lower blood pressure.
3. **Antifertility Activity** :- Root and leaf extracts of *Moringa oleifera* have demonstrated antifertility effects in experimental studies, indicating potential contraceptive properties.
4. **Anti-asthmatic Activity** :- Seed kernel powder has shown beneficial effects in patients with mild to moderate asthma by improving lung function and reducing the severity of asthmatic symptoms.

5. **Anticancer Activity** :- Leaf and seed extracts possess anticancer properties. Their bioactive compounds inhibit tumour growth and reduce the activity of tumour-promoting agents.
6. **Antimicrobial Activity** :- Leaves, seeds, roots, and bark exhibit broad-spectrum antimicrobial activity against bacteria, fungi, and other microorganisms, including *Staphylococcus aureus* and *Pseudomonas aeruginosa*.
7. **Anti-inflammatory Activity** :- Extracts prepared from the leaves, flowers, seeds, bark, and roots show significant anti-inflammatory effects by reducing inflammation in experimental models.
8. **Central Nervous System (CNS) Activity** : - *Moringa oleifera* extracts demonstrate neuroprotective and anticonvulsant activities by restoring brain neurotransmitter levels and reducing seizure activity in animal studies.
9. **Dental Caries** :- Leaf extracts inhibit the growth of *Streptococcus mutans* and reduce cariogenic biofilm formation, suggesting their potential use in preventing dental caries and improving oral health.

11.conclusion

The present study successfully formulated and evaluated Moringa oleifera lozenges. The prepared lozenges showed acceptable physicochemical properties, including uniform weight, suitable thickness, adequate hardness, low friability, and uniform drug content (approximately 99%). The dissolution study demonstrated effective drug release, with about 92% of the active constituents released within 30 minutes. The presence of flavonoids, phenolic compounds, vitamins, and minerals in Moringa oleifera contributes to its antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory activities. The formulated lozenges have the potential to relieve throat irritation, reduce oral microbial growth, and provide both therapeutic and nutritional benefits.

Overall, the developed Moringa oleifera lozenges demonstrated good quality, stability, and patient acceptability, making them a promising herbal dosage form for oral healthcare.

12. future prospects

Moringa oleifera lozenges have promising future potential as herbal and nutraceutical products for the management of throat infections, cough, sore throat, and oral microbial diseases. Their rich content of antioxidants, vitamins, minerals, and bioactive compounds may also support immunity and overall health. Future research should focus on improving formulation stability, taste masking, patient acceptability, and shelf life using advanced formulation techniques. Further preclinical and clinical studies are required to establish the safety and therapeutic efficacy of the lozenges.

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